

Please type a plus sign (+) inside this box → ☐

PTO/SB/29 (2/98)  
Approved for use through 09/30/2000. OMB 0651-0032  
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

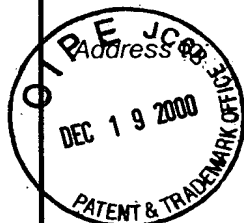
## CONTINUED PROSECUTION APPLICATION (CPA) REQUEST TRANSMITTAL

Submit an original, and a duplicate for fee processing.

(Only for Continuation or Divisional applications under 37 C.F.R. § 1.53(d))

CHECK BOX, if applicable:

☐ **DUPLICATE**



Assistant Commissioner for Patents  
Box CPA  
Washington, DC 20231

Attorney Docket No.	511.33114VV5
First Named Inventor	HAGIWARA, et al.
Examiner Name	J. Chu
Group / Art Unit	1752
Express Mail Label No.	

This is a request for a ☒ continuation or ☐ divisional application under 37 C.F.R. § 1.53(d),  
(continued prosecution application (CPA)) of prior application number 09 / 482,859,  
filed on January 14, 2000, entitled PHOTOSENSITIVE RESIN COMPOSITION.

### NOTES

**FILING QUALIFICATIONS:** The prior application identified above must be a nonprovisional application that is either: (1) complete as defined by 37 C.F.R. § 1.51(b), or (2) the national stage of an international application in compliance with 35 U.S.C. 371. A Notice will be placed on a patent issuing from a CPA, except for reissues and designs, to the effect that the patent issued on a CPA and is subject to the twenty-year patent term provisions of 35 U.S.C. § 154(a)(2). Therefore, the prior application of a CPA may have been filed before, on or after June 8, 1995.

**C-I-P NOT PERMITTED:** A continuation-in-part application cannot be filed as a CPA under 37 C.F.R. § 1.53(d), but must be filed under 37 C.F.R. § 1.53(b).

**EXPRESS ABANDONMENT OF PRIOR APPLICATION:** The filing of this CPA is a request to expressly abandon the prior application as of the filing date of the request for a CPA. 37 C.F.R. § 1.53(b) must be used to file a continuation, divisional, or continuation-in-part of an application that is not to be abandoned.

**ACCESS TO PRIOR APPLICATION:** The filing of this CPA will be construed to include a waiver of confidentiality by the applicant under 35 U.S.C. 122 to the extent that any member of the public who is entitled under the provisions of 37 C.F.R. § 1.14 to access to, copies of, or information concerning, the prior application may be given similar access to, copies of, or similar information concerning, the other application or applications in the file jacket.

**35 U.S.C. 120 STATEMENT:** In a CPA, no reference to the prior application is needed in the first sentence of the specification and none should be submitted. If a sentence referencing the prior application is submitted, it will not be entered. A request for a CPA is the specific reference required by 35 U.S.C. 120 and to every application assigned the application number identified in such request, 37 C.F.R. § 1.78(a).

- ☐ Enter the unentered amendment previously filed on \_\_\_\_\_ under 37 C.F.R. § 1.116 in the prior nonprovisional application.
- ☒ A preliminary amendment is enclosed.
- This application is filed by fewer than all the inventors named in the prior application, 37 C.F.R. § 1.53(d)(4).
  - ☐ **DELETE** the following inventor(s) named in the prior nonprovisional application:  
.....
  - ☐ The inventor(s) to be deleted are set forth on a separate sheet attached hereto.
- ☐ A new power of attorney or authorization of agent (PTO/SB/81) is enclosed.
- Information Disclosure Statement (IDS) is enclosed:
  - ☐ PTO-1449
  - ☐ Copies of IDS Citations

[Page 1 of 2]

Burden Hour Statement: This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box CPA, Washington, DC 20231.

12/20/2000  
01-FC:131  
02-FC:103

Please type a plus sign (+) inside this box → +

PTO/SB/29 (12/97)  
Approved for use through 09/30/00. OMB 0651-0032  
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	22 -20 =	2	x \$18.00 =	\$ 36.00
	INDEPENDENT CLAIMS(37 CFR 1.16(b))	3 -3 =	0	x \$ _____ =	
	MULTIPLE DEPENDENT CLAIMS (if applicable)(37 CFR 1.16(d))			+ \$ _____ =	
				BASIC FEE (37 CFR 1.16(a))	710.00
				Total of above Calculations =	36.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
				TOTAL =	\$746.00

6. Small entity status:

- a. ☐ A small entity statement is enclosed.  
b. ☐ A small entity statement was filed in the prior nonprovisional application  
and such status is still proper and desired.  
c. ☐ Is no longer claimed.

7. The Commissioner is hereby authorized to credit overpayments or charge any shortages to  
Deposit Account No. 01 - 2135 in connection with these fees.

8. ☐ A check in the amount of \$ \_\_\_\_\_ is enclosed.

9. ☒ Other: Copy of Declaration of M. Kaji filed in prior application  
Serial No. 09/136,610

**NOTE:**

*The prior application's correspondence address will carry over to this CPA  
UNLESS a new correspondence address is provided below.*

**10. CORRESPONDENCE ADDRESS**

☒ Customer Number or Bar Code Label

020457

(Insert Customer No. or Attach bar code label here)

**11. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED**

NAME Alan B. Schiavelli

SIGNATURE [Signature]

DATE

December 19, 2000

REG. NO.

32,087

**ANTONELLI, TERRY, STOUT & KRAUS, LLP**

SUITE 1800

1300 NORTH SEVENTEENTH STREET

ARLINGTON, VIRGINIA 22209

TELEPHONE  
(703) 312-6600

FACSIMILE

(703) 312-6666

E-MAIL

email@antonelli.com

RECEIVED  
703 312 6600

#8

IN THE UNITED STATES PATENT  
AND TRADEMARK OFFICE

Applicant(s): Hideo HAGIWARA et al  
Serial No.: 09/136,610  
Filed: August 20, 1998  
For: PATTERN-FORMING PROCESS USING PHOTSENSITIVE RESIN  
COMPOSITION  
Art Unit: 1752  
Examiner: John Chu

Honorable Commissioner of Patents  
and Trademarks  
Washington, D.C. 20231

DECLARATION UNDER 37 CFR 1.132

SIR:

I. I, Makoto KAJI, a citizen of Japan and having an address of 3-6, Daihara-cho 2-chome, Hitachi-shi, Ibaraki-ken, Japan, declare and say as follows.

I am one of the joint inventors of the present U.S. Patent Application as identified above and understand the English language. I studied the Official Action dated March 30, 2000 received in said application.

In order to clarify that the present invention is not obvious over the invention of Ohbayashi et al. (U.S. Patent No. 4,783,391) and Aldrich et al. (U.S. Patent No. 5,399,460), I have conducted comparative experiments as mentioned below under my supervision.

II. Comparative experiments

An object of the experiments is to show the superiority of

the process according to the present invention to those of Ohbayashi et al. and Aldrich et al.

To show the difference in the characteristics of the resulting products between the method of Ohbayashi et al or Aldrich et al. and that of the present invention, the following Samples No. 1 to No. 20 were prepared and evaluated.

Sample No. 1 (Ohbayashi et al.)

Pattern was prepared in the same manner as mentioned in Example 1 of Ohbayashi et al. (See Column 11, lines 24 to 51 of Ohbayashi et al.).

Sample No. 2 (the composition is within the scope of the present invention)

Pattern was prepared in the same manner as those of Sample No. 1 except for changing acid anhydride in the above Sample No. 1 to the equivalent mole of ODPA (oxydiphthalic acid anhydride) as shown in Table 1 and except for changing photoinitiator to CA (2,6-bis(4'-azidobenzal)-4-carboxycyclohexanone, PDO (1-phenyl-2-(O-ethoxycarbonyl)oxyiminopropan-1-one) and EAB (4,4'-bis(diethylamino)benzophenone) and the amine to MDAP (N,N-dimethylaminopropyl methacrylate), with a thickness of 20  $\mu\text{m}$  and exposure of  $10\text{mW}/\text{cm}^2 \times 40\text{s}$ .

Sample No. 3 (Sample of Ohbayashi et al.)

Pattern was prepared in the same manner as those of Sample No. 1 except for changing the thickness thereof to 20  $\mu\text{m}$  and changing the exposure of  $10\text{mW}/\text{cm}^2 \times 40\text{s}$ .

Sample No. 4 (Sample of Ohbayashi et al.)

Pattern was prepared in the same manner as mentioned in Example 1 of Ohbayashi et al. except for changing the photoinitiator

to CA, PDO and EAB and the amine to MDAP as shown in Table 1, changing the thickness thereof to 20  $\mu\text{m}$  and changing the exposure of  $10\text{mW}/\text{cm}^2 \times 20\text{s}$ .

Sample No. 5 (Example 6 of the present invention)

To a 200 ml-flask equipped with a stirrer, a thermometer and an inlet for introducing nitrogen gas were added 19.5931 g of 4,4'-diaminodiphenyl ether, 1.2799 g of 1,3-bis(3-aminopropyl)-1,1,3,3-tetramethyldisiloxane, 4.4536 g of water, 29.26 g of  $\gamma$ -butyrolactone and 117.02 g of N-methyl-2-pyrrolidone and the mixture was dissolved by stirring at room temperature under nitrogen flow. Then, 33.2295 g of ODPAs was added to the solution and the mixture was stirred for 5 hours to have a polyamic acid (polyimide precursor) solution. The solution was then heated at 70 °C for adjusting the viscosity at 80 poise.

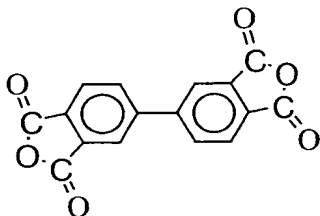
To 10 g of the polyamic acid (polyimide precursor) solution were added 1.803g of MDAP, 0.027g of CA, 0.027g of EAB and 0.054g of PDO and mixed while stirring to have uniform photosensitive resin composition solutions.

The obtained solution was filtered and was drip spin-coated on a silicon wafer. Then, the wafer was heated at 100 °C for 150 seconds by using a hot plate to form a film having a thickness of 20 micrometers, and the film was exposed to broad band stepper through a mask with patterns ( $10\text{mW}/\text{cm}^2 \times 40\text{s}$ ). The film was heated at 110 °C for 50 seconds and subjected to puddle development using a mixed solution comprising N-methyl-2-pyrrolidone and water with a weight ratio of 75 : 25. Then, the film was heated at 100 °C for 30 minutes, at 200 °C for 30 minutes and then at 350 °C for 60 minutes under nitrogen atmosphere to have the relief pattern of the polyimide.

Sample No. 6 (Sample of the present invention)

Pattern was prepared in the same manner as those mentioned

in Sample No. 5 except for changing the acid anhydride (ODPA) used in the above Sample No. 5 with ODPA/sBPDA (s-biphenyltetracarboxylic dianhydride) = 80/20.



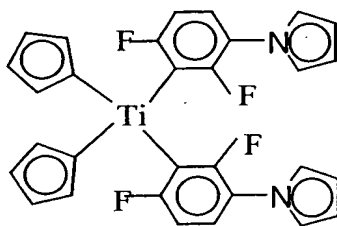
s-biphenyltetracarboxylic dianhydride

Sample No. 7 (Sample of the present invention)

Pattern was prepared in the same manner as those mentioned in Sample No. 5 except for changing the polyimide to an ester-bonding type polyimide precursor (oxydiphthalic acid dianhydride is reacted with a 2-fold molar amount of hydroxyethyl methacrylate to subject to esterification, then, thionyl chloride was reacted to the resulting compound to give a diesterification-dichlorination compound and the resulting compound is reacted with an equimolar amount of diamine (DDE: 3,4'-diaminodiphenyl ether), and amounts of the polymerization initiators (CA, PDO and EAB) to those as shown in Table 2.

Sample No. 8 (Sample of the present invention)

Pattern was prepared in the same manner as those mentioned in Sample No. 5 except for changing the polymerization initiator to the following compound (hereinafter abbreviated to as "Ti").



Samples No. 9 to No. 18 (Samples of Aldrich et al.)

Patterns were each prepared in the same manner as those mentioned in respective Examples of Aldrich et al. as shown in Table 3.

Sample No. 19 (revised Example 16 of Aldrich et al.)

Pattern was prepared in the same manner as mentioned in Example 16 of Aldrich et al. except for changing the thickness thereof from 16  $\mu\text{m}$  to 20  $\mu\text{m}$ .

Sample No. 20 (revised Example 21 of Aldrich et al.)

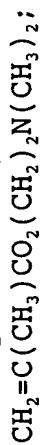
Pattern was prepared in the same manner as mentioned in Example 21 of Aldrich et al. except for changing the thickness thereof from 16  $\mu\text{m}$  to 20  $\mu\text{m}$ .

Evaluations of the patterns were carried, and the results are shown in Tables 1 to 3. The resolution, the pattern and the residual thickness were evaluated using the methods as mentioned in the present specification (see page 25 of the present specification).

Table 1

No.	Polyimide		Photoinitiator				Amino- acrylate (**)	Thick- ness ( $\mu$ m)	Exposure	Resolu- tion ( $\mu$ m)	Pattern	Residual thickness (%)
	Dianhyd- ride	Diamine	4- azidobenzal- acetophenone	CA	PDO	EAB						
1	BTDA	DDE	0.034	0	0	0	MDAE	5	B/B	8	Good	78
2	ODPA	DDE	0	0.027	0.054	0.027	MDAP	20	B/B	12	Good	99
3	BTDA	DDE	0.034	0	0	0	MDAE	20	B/B	60	Serious Undercut	58
4	BTDA	DDE	0	0.027	0.054	0.027	MDAP	20	B/B	40	Undercut	65

MDAE: (dimethylaminoethyl methacrylate):



MDAP: (N,N-dimethylaminopropyl methacrylate):



CA: (2,6-bis(4'-azidobenzal)-4-carboxycyclohexanone):

EAB: (4,4'-bis(diethylamino)benzophenone):

PDO: (1-phenyl-2-(O-ethoxycarbonyl)oxyiminopropan-1-one):

\*: All formulations were shown as a ratio(g) to 10 gram of polyamic acid solution.

\*\*: Aminoacrylate was formulated so that its molar matches stoichiometric to carboxylic acid.

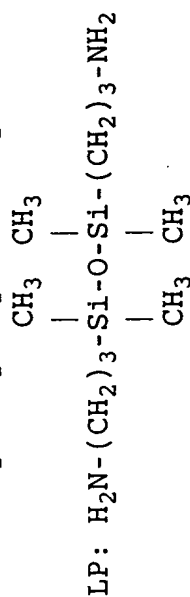


Table 2

No.	Polyimide		Photoinitiator				Amino- acrylate (MDAP)	Thick- ness ( $\mu\text{m}$ )	Exposure	Resolu- tion ( $\mu\text{m}$ )	Pattern	Residual thickness (%)
	Dianhydride	Diamine	CA	PDO	EAB	Ti						
5	ODPA	DDE/LP (95/5)	0.027	0.054	0.027	0	1.803	20	B/B	15	Good	99
6	ODPA/sBPDA (80/20)	DDE/LP (95/5)	0.027	0.054	0.027	0	1.773	20	B/B	15	Good	95
7	ODPA/HEMA (**)	DDE	0.043	0.086	0.043	0	0	20	B/B	10	Good	99
8	ODPA	DDE/LP (95/5)	0	0	0	0.027	1.803	20	B/B	10	Good	99

sBPDA: Same as mentioned above.

HEMA: Hydroxyethylmethacrylate



\*: All formulations were shown as a ratio(g) to 10 gram of polyamic acid solution.

\*\*: Acid chloride method was used in order to prepare this polyamic ester.

Table 3

No.	Polyimide		Photoinitiator (*)	Amino- acrylate (**)	Thick- ness ( $\mu$ m)	Exposure (***)	Resolu- tion ( $\mu$ m)	Pattern	Residual thickness (%)	Example Nos. of Aldrich et al.
	Dianhyd- ride	Diamine								
9	BPDA	PPD	composition(iii)	B-3(50)	20	B/B	20	Undercut	65	30
10	BPDA	PPD	composition(iii)	B-1(25)	20	B/B	50	Undercut	42	31
11	BPDA	PPD	composition(iii)	B-1(50)	20	B/B	40	Undercut	63	32
12	BPDA	PPD	composition(iii)	B-1(100)	20	B/B	20	Undercut	78	33
13	BPDA	PPD	composition(iii)	B-2(25)	20	B/B	60	Undercut	51	34
14	BPDA	PPD	composition(iii)	B-2(50)	20	B/B	40	Undercut	58	35
15	BPDA	PPD	composition(iii)	B-2(100)	20	B/B	30	Undercut	75	36
16	BPDA	PPD	composition(iii)	B-3(50)	16	B/B	8	Good	85	2
17	BTDA	MPD/ODA	composition(iii)	B-3(50)	16	B/B	5	Good	80	16
18	PMDA	ODA	composition(iii)	B-3(50)	16	B/B	6	Good	70	21
19	BTDA	MPD/ODA	composition(iii)	B-3(50)	20	B/B	20	Undercut	65	Revision of 16 Changing thickness
20	PMDA	ODA	composition(iii)	B-3(50)	20	B/B	20	Undercut	69	Revision of 21 Changing thickness

BPDA: 3,3',4,4'-biphenyl tetracarboxylic dianhydride:

BTDA: 3,3',4,4'-benzophenone tetracarboxylic dianhydride:

PMDA: pyromellitic dianhydride:

PPD: p-phenylene diamine:

MPD: m-phenylene diamine:

ODA: 4,4'-diaminodiphenyl ether:

\*: As for photoinitiator, equimolar amount of similarly employable isoamyl N,N-dimethylaminobenzoate was used instead of 2,3,6,7-tetrahydro-1,1,7,7-tetramethyl-11-oxo-1H,5H,11H-(1)benzopyrano[5,7,8-ij]quinoline-10-carboxylic acid ethyl ester of composition (iii) in the Table at column 14 because the latter was not available.

\*\* : The numerical values in the brackets are equivalent & which matches theoretical amount of carboxylic group.

\*\*\*: exposure took Kark Suss Model MA56W.

Note: The exposure conditions were 12 mW/cm<sup>2</sup> × 80s for Samples No. 9 - No. 15, No. 19 - No. 20 and 12 mW/cm<sup>2</sup> × 67s for Samples No. 16 - No. 18.

### Consideration of experimental results

As can be seen from the results shown in Table 1, it can be understood that Sample No. 1 of Ohbayashi et al. shows good results by effecting exposure under the conditions of Ohbayashi et al. However, the thickness of this sample is increased (Samples No. 3 and No. 4), undercut occurs in the sample and good resolution could never be obtained.

In the samples of the present invention (Samples No. 5 to No. 8), good patterns with high resolution could be obtained with a wide range of the compositions as shown in Table 2.

From the results shown in Table 3, it can be understood that Samples No. 16 to No. 18 of Aldrich et al. show good results by effecting exposure under the conditions of Aldrich et al. However, the thickness of these samples are increased (Samples No. 9 to No. 15, No. 19 and No. 20), undercut occurs in the samples and no good resolution can be obtained.

### III. Conclusion

I believe that the above results would indeed be surprising and could never be expected from the description of Ohbayashi et al. or Aldrich et al. Thus, I do not believe that the present invention is obvious over Ohbayashi et al. or Aldrich et al.

IV. I further declare that all statements made herein of my own knowledge are true and that all statements made in information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the

like so made are punishable by fine or imprisonment, or both, under Section 1001, of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: Aug. 22/'00

Makoto Kaji  
Makoto KAJI